



Stabilization and Reuse of Heavy Metal Contaminated Soil by Means of Quicklime-Sulfate



Developer: Stevens Institute of Technology
Contract Number: DE-AC21-92MC29117
Crosscutting Area: N/A

Subsurface
Contaminants
FOCUS AREA

Problem:

Capillary and hydraulic flows of water in porous media contaminated by heavy metal species has resulted in aquifer contamination. Removal of heavy metals from the contaminated soil is energy intensive and time consuming, since the mobility of heavy metal ions such as arsenic, chromium, lead, and mercury is orders of magnitude slower than in water.

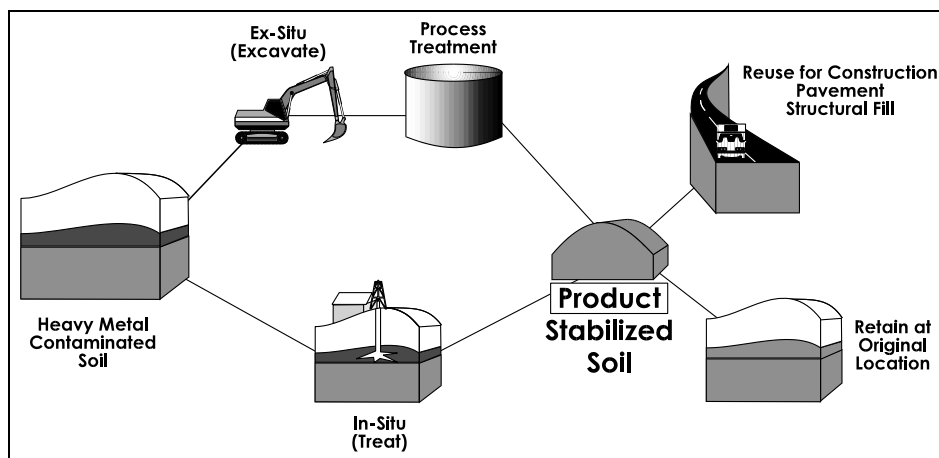
Solution:

Demonstrate a cost-effective process for heavy metal stabilization/immobilization by means of quicklime-sulfate salt treatment. This process has the potential for in situ treatment by injection as well as on-site stabilization by excavation, mixing, and compaction. Chemical admixtures, most commonly quicklime and sulfate salt, improve the strength and durability of soils by ion exchange and cementitious reactions, to enable their use as engineering materials in the construction of road subgrades and structural fills.

Benefits:

- Stabilization of heavy metal species in the soil matrix
- Stabilization renders contaminants inaccessible for dissolution into water bodies
- Time saving and cost effective

lime is readily soluble and available for reactions, and its addition to a soil material results in larger pH increases than any other available additive. The time required for remediation could be reduced as compared to other additives, since as the resulting pH increases, the reactivity of the stabilized system increases as well. Quicklime is less



Technology:

This project used a chemical admixture stabilization approach, where heavy metal immobilization was achieved by means of quicklime (CaO) and a sulfate salt. Quicklime has several advantages over cement and fly ash stabilization. First, the

expensive than cement, and a more homogeneous material.

Finally, dealing with high water content wastes or low temperature regions, quicklime (CaO) is a much more effective additive; just its heat of hydration can be substantial in accelerating other on-going



reactions, and reducing the time required for remediation. The subsequent drying of the surrounding ground can be a significant outcome.

A laboratory program was conducted using artificial soil samples, composed of a clay-sand matrix mixed with heavy metals. The heavy metals included arsenic, chromium, lead, and mercury. The optimum levels of quicklime treatment were then determined.

Contaminated soil mixes were treated and tested for stress-strain properties, leachability, micromorphology, mineralogical composition, permeability, setting time, and durability, so that the effectiveness of the process could be verified and optimized, and the underlying mechanisms responsible for stabilization established. Influence of important soil and contamination parameters on the effectiveness of the proposed process were assessed.

Project Conclusion:

This contract was terminated in February 1995 at the end of Phase I. The work focused on immobilization of lead, chromium, arsenic and mercury contamination in soils. Lead and arsenic contamination in soils is not a major concern within the Department of Energy (DOE). The DOE is investigating more innovative methods to manage chromium contamination in soils. Application of the quicklime/sulfate salt

treatment method to mercury-contaminated soil did not consistently reduce the leaching potential of mercury to below Toxicity Characteristic Leaching Procedure (TCLP) requirements. Also, there are concerns regarding whether the U.S. EPA or state environmental regulatory organizations would accept the in-situ treatment of soils by this technology since it does not physically remove the contamination from the soil.

Contacts:

Stevens Institute of Technology is committed to research and development of cost-effective technologies for environmental restoration and waste management. For information on this project, the contractor contact is:

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DOE's Morgantown Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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